

REMARKS

The Office Action dated February 22, 2006, has been received and carefully noted. The following remarks are submitted as a full and complete response thereto. Claims 26-45 are pending and respectfully submitted for consideration.

Rejections Under 35 U.S.C. § 103

Claims 31, 33-34 and 37-40 were rejected under 35 U.S.C. § 102(e) as being anticipated by Asakawa et al. (U.S. Patent No. 5,795,385, "Asakawa") in view of Zhang et al. (U.S. Patent No. 5,766,344, "Zhang"). As a preliminary matter, the Applicants respectfully submit that the rejection under 35 U.S.C. § 102(e) is in error and that the rejection is under 35 U.S.C. § 103(a). See paragraph 2 of the Office Action. Claim 31 depends from claim 33. Claims 33, 34 and 37-40 are independent claims. Asakawa was cited for disclosing many of the claimed elements of the invention with the exception of using an energy beam consisting of a laser beam or an electron beam to produce an intended crystalline silicon film. Zhang was cited for curing this deficiency. The Applicants traverse the rejection and respectfully submit that claims 31, 33-34 and 37-40 recite subject matter that is neither disclosed nor suggested by the cited references.

Asakawa discloses an apparatus for forming a single-crystalline thin film of a prescribed material on a substrate, comprising film forming means for forming an amorphous or a polycrystalline thin film of the prescribed material on the substrate by supplying a reaction gas, irradiation means for irradiating the substrate with gas beams of low energy levels and a substrate rotating means for rotating the substrate. The apparatus comprises substrate rotating means, whereby it is possible to facilitate

formation of an amorphous or polycrystalline thin film by intermittently applying the beams while regularly supplying the reaction gas and rotating the substrate during application pauses. See column 11, line 55 to column 12, line 4 of Asakawa. Asakawa further discloses that the irradiation means preferably comprises an electron cyclotron resonance type ion source, and the gas beams are supplied by the ion source. See column 12, lines 47-49 of Asakawa.

Zhang discloses a method for forming a semiconductor, wherein the processes from the film forming to the laser irradiation may be effected in succession, without a transfer of sample, by using such plasma CVD apparatus as is provided with a high vacuum exhausting device having a window of quartz, etc., so that a laser can be irradiated from the outside, instead of the chamber being exclusively used in the laser annealing.

The Applicants respectfully submit that Asakawa fails to disclose additional features of the invention beyond those acknowledged in the Office Action, as discussed below and that Zhang fails to cure the deficiencies in Asakawa.

Claims 33, 34 and 37-40 recite the step of "preparing a film forming apparatus ...provided with a film forming device for forming a pre-film of the crystalline silicon film on a target surface of the substrate, an ion source for emitting an ion beam to the target surface of the substrate, and an energy beam irradiating device for irradiating the pre-film with an energy beam for crystallizing the pre-film." (Emphasis added). The Office Action took the position that Asakawa discloses these features of the invention. However, the Applicants respectfully submit that Asakawa does not disclose or suggest at least the combination of using both an ion source and an energy beam irradiating

device. With respect to claims 33, 34 and 37-40, Asakawa merely discloses an irradiation means comprising an electron cyclotron resonance type ion source, which is not comparable to the energy beam irradiating device recited in claims 33, 34 and 37-40. Specifically, Asakawa merely discloses an ion source for irradiation, but not an energy beam as recited in claims 33, 34 and 37-40.

The Applicants further submit that Zhang fails to cure the deficiencies in Asakawa with respect to claims 33, 34 and 37-40 because Zhang also does not teach or suggest using both an ion source and an irradiating device as recited in the claims as discussed below.

The Office Action acknowledged that Asakawa does not disclose or suggest using an energy beam consisting of a laser beam or an electron beam to produce an intended crystalline silicon film. The Office Action took the position that Zhang teaches this feature and that it would have been obvious to one of ordinary skill in the art to modify Asakawa by crystallizing the thin film or silicon film 82 with laser light as taught by Zhang to "improve the crystallinity of the silicon film." See page 4, lines 13-15 of the Office Action. However, there is no disclosure or suggestion in Zhang or the cited references that using a laser light would or could improve the crystallinity of silicon film. Therefore, the Applicants respectfully submit that there is no reason to combine Asakawa and Zhang as suggested in the Office Action. Under U.S. patent practice, the mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. See MPEP § 2143.01 and In re Mills, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990). The Applicants respectfully submit that there is no suggestion of the

desirability of combining Asakawa and Zhang because Zhang does not teach or suggest a laser to improve the crystallinity of silicon film. In this regard, the Applicants respectfully request that the Examiner point out where in Zhang the teaching of improving the crystallinity of the silicon film is disclosed.

Claims 39 and 40 further recite forming the pre-film of the crystalline silicon film on the target surface of the substrate by the film forming device, wherein the ion beam is emitted to the target surface of the substrate from the ion source during a period from a stage before the pre-film forming step of forming the pre-film by the film forming device to an initial stage of the pre-film forming step.

The Office Action took the position that Asakawa teaches that it is possible to facilitate formation of an amorphous thin film by intermittently applying beams from an ion source while regularly supplying a reaction gas and rotating the substrate during application pauses. See page 3, lines 10-13 of the Office Action. However, the teachings of Asakawa noted in the Office Action, are not comparable to the claimed features of the ion beam being emitted to the target surface of the substrate from the ion source during a period from a stage before the pre-film forming step of forming the pre-film by the film forming device to an initial stage of the pre-film forming step, as recited in claims 39 and 40. As such, the Office Action has not identified the recitation of the above claimed features in Asakawa.

Zhang further fails to cure the deficiencies in Asakawa with respect to claims 39 and 40 as Zhang also does not disclose or suggest at least the feature of the ion beam being emitted to the target surface of the substrate from the ion source during a period

from a stage before the pre-film forming step of forming the pre-film by the film forming device to an initial stage of the pre-film forming step.

In view of the above, the Applicants respectfully submit that the combination of Asakawa and Zhang fails to disclose or suggest at least the combination of features of “preparing a film forming apparatus . . . provided with a film forming device for forming a pre-film of the crystalline silicon film on a target surface of the substrate, an ion source for emitting an ion beam to the target surface of the substrate, and an energy beam irradiating device for irradiating the pre-film with an energy beam for crystallizing the pre-film” as recited in claims 33, 34, 37 and 38. The combination of Asakawa and Zhang further fails to disclose or suggest at least the combination of features of “preparing a film forming apparatus . . . provided with a film forming device for forming a pre-film of the crystalline silicon film on a target surface of the substrate, an ion source for emitting an ion beam to the target surface of the substrate, and an energy beam irradiating device for irradiating the pre-film with an energy beam for crystallizing the pre-film, and forming the pre-film of the crystalline silicon film on the target surface of the substrate by the film forming device, wherein the ion beam is emitted to the target surface of the substrate from the ion source during a period from a stage before the pre-film forming step of forming the pre-film by the film forming device to an initial stage of the pre-film forming step, as recited in claims 39 and 40.

Claims 26-30, 35-36 and 41-45 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Asakawa in view of Zhang and further in view of Selvakumar et al. (U.S. Patent No. 5,633,194, “Selvakumar”). Claim 26 depends from claim 33, claim 27 depends from claim 35, claims 28 and 29 depend from claim 37, claims 30 and 42

depend from claim 36, claim 41 depends from claim 34, claims 43 and 44 depend from claim 38 and claim 45 depends from claim 39. The Applicants respectfully submit that claims 26-30, 35-36 and 41-45 recite subject matter that is neither disclosed nor suggested by the cited references.

Selvakumar discloses low temperature ion-beam assisted deposition methods for realizing SiGe/Si heterostructure wherein in-situ cleaning of the substrate surface was done by argon ion bombardment prior to the start of deposition.

As a preliminary matter, the Applicants note the Examiner's statement that "[t]he combination of Asakawa et al and Zhang et al teaches all of the limitations of claim 35, as discussed previously in claim 33, an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film." See page 5, lines 15-17 of the Office Action. However, as discussed above with respect to claims 39 and 40, the Office Action did not assert that the combination of Asakawa and Zhang discloses that the ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film in Asakawa. Further, the Office Action did not assert that this limitation was met by Zhang. As such, the combination of Asakawa and Zhang does not disclose or suggest the claimed features of the invention.

In addition, with respect to claims 35 and 36, Asakawa fails to disclose or suggest additional features of the invention beyond those acknowledged in the Office Action. Specifically, Asakawa does not disclose or suggest a film forming device for forming a pre-film of the crystalline silicon film on the target surface of the substrate, an ion source for emitting an ion beam to the target surface of the substrate, and an energy

beam irradiating device for irradiating the pre-film with an energy beam for crystallizing the pre-film.

Zhang and Selvakumar fail to cure the deficiencies in Asakawa with respect to claims 35 and 36, as Zhang and Selvakumar also does not disclose or suggest at least the combination of using both an ion source and an energy beam irradiating device. As such, the combination of Asakawa, Zhang and Selvakumar fails to disclose or suggest each and every feature of the invention, as recited in claims 35 and 36.

Claim 32 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Asakawa in view of Zhang as applied to claims 31, 33-34 and 37-40 above, and further in view of Ahn et al. (U.S. Patent No. 5,470,619, "Ahn"). Claim 32 depends from claims 31 and 33. The Office Action took the position that the combination of Asakawa and Zhang discloses all of the limitations of the claimed invention with the exception of a plasma CVD using hydrogen gas. Ahn was cited for curing this deficiency.

Ahn discloses a washed substrate placed in a PECVD chamber or a LPCVD chamber and heated at a temperature sufficient to degas it, for example, at about 400°C. The degassed substrate is heated ranging from room temperature to 600°C in the atmosphere of a source gas to deposit an amorphous silicon thin film thereon. As a source gas, Si₂H₆ gas is preferably used over SiH₄ gas. However, SiH₄ gas which is less expensive than Si₂H₆ gas, for example, Ar-, He-, H₂- or N₂-diluted SiH₄ gas, can be used as a source gas. See column 3, lines 38-50 of Ahn.

The Applicants respectfully submit that Ahn fails to cure the deficiencies in Asakawa and Zhang with respect to claim 33, from which claim 32 depends, and that claim 32 is allowable at least because of its dependency from claims 31 and 33.

Under U.S. patent practice, the PTO has the burden under §103 to establish a *prima facie* case of obviousness. In re Fine, 5 USPQ2d 1596, 1598 (Fed. Cir. 1988). Both the case law of the Federal Circuit and the PTO itself have made clear that where a modification must be made to the prior art to reject or invalidate a claim under §103, there must be a showing of proper motivation to do so. The mere fact that a prior art reference could arguably be modified to meet the claim is insufficient to establish obviousness. The PTO can satisfy this burden only by showing some objective teaching in the prior art or that knowledge generally available to one of ordinary skill in the art would lead that individual to combine the relevant teachings of the references. Id. In order to establish obviousness, there must be a suggestion or motivation in the reference to do so. See also In re Gordon, 221 USPQ 1125, 1127 (Fed. Cir. 1984) (prior art could not be turned upside down without motivation to do so); In re Rouffet, 149 F.3d 1350 (Fed. Cir. 1998); In re Dembiczak, 175 F.3d 994 (Fed. Cir. 1999); In re Lee, 277 F.3d 1338 (Fed. Cir. 2002). The Office Action restates the advantages of the present invention to justify the combination of references. There is, however, nothing in the applied references to evidence the desirability of these advantages in the disclosed structure.

In view of the above, the Applicants respectfully submit that Asakawa, Zhang, Selvakumar and Ahn, either singly or in combination, fail to disclose or suggest the claimed features of the invention. As such, the Office Action has failed to establish a *prima facie* case of obviousness for purposes of a rejection of claims 26-45 under 35 U.S.C. § 103.

Conclusion

Claims 26, 31 and 32 depend from claim 33; claim 41 depends from claim 34; claim 27 depends from claim 35; claims 30 and 42 depend from claim 36; claims 28 and 29 depend from claim 37; claims 43 and 44 depend from claim 38; claim 45 depends from claim 39.

The Applicants respectfully submit that these dependent claims incorporate the patentable aspects thereof and are allowable for at least the same reasons. Accordingly, the Applicants respectfully request withdrawal of the rejections, allowance of claims 26-45, and the prompt issuance of a Notice of Allowability.

Should the Examiner believe anything further is desirable in order to place this application in better condition for allowance, the Examiner is requested to contact the undersigned at the telephone number listed below.

In the event this paper is not considered to be timely filed, the Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to counsel's Deposit Account No. 01-2300, **referencing Attorney Dkt. No. 107351-00011.**

Respectfully submitted,



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